The Spanish Journal of Psychology
2010, Vol. 13 No. 2, 951-960

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ISSN 1138-7416

Spanish Adaptation of the NDSS (Nicotine Dependence Syndrome Scale) and Assessment of Nicotine-Dependent Individuals at Primary Care Health Centers in Spain

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The availability of adequate instruments for the assessment of nicotine dependence is an important factor that is relevant in the area of tobacco addiction. In this study, we present a Spanish validation of the Nicotine Dependence Syndrome Scale (NDSS) (Shiffman, Waters, & Hickcox, 2004). The sample was composed of patients, all daily smokers, who visited their General Practitioner (GP) at five Primary Health Care Centers in different cities of Spain (N = 637). The results indicated adequate reliability for the general factor that assesses nicotine dependence (NDSS-Total) (Cronbach's α = .76). Factor analysis confirms the five factors of the original validation: Drive, Continuity, Stereotypy, Priority, and Tolerance. It must be noted that reliability is adequate for the first, and moderate or low for the rest. The NDSS-T and its scales correlate significantly with the Fagerström Test for Nicotine Dependence (FTND), with the nicotine dependence criteria of the Diagnostic and Statistical Manual of Mental Disorders IV (DSM-IV) as assessed through the Structured Clinical Interview for DSM-IV (SCID), with carbon monoxide levels in expired air (CO), and with the number of cigarettes smoked. The ROC curve indicates that the NDSS-T has a score of .79 which is under the curve (.69 for the FTND), thus the prediction of nicotine dependence is adequate. We conclude that this instrument is useful (in terms of its total score NDSS-T) for assessing nicotine dependence for Spanish smokers (in Spain), as has been found in other countries, language groups, and cultures.

Keywords: smoking, assessment, dependence, nicotine, NDSS.

Disponer de adecuados instrumentos de evaluación de la dependencia de la nicotina es un aspecto relevante en el área de la adicción al tabaco. En este estudio se presenta la validación española de la Escala del Síndrome de la Dependencia de la Nicotina (NDSS, Shiffman, Waters y Hickcox, 2004). La muestra estuvo formada por fumadores diarios de cigarrillos que acudieron a su médico de Atención Primaria en cinco centros de salud de diferentes ciudades de España (N = 637). Los resultados indican una adecuada fiabilidad para el factor general que evalúa dependencia de la nicotina (NDSS-Total) (α de Cronbach = .76). El análisis factorial confirma los cinco factores obtenidos en la validación original de la escala: Impulso, Continuidad, Estereotipia, Prioridad y Tolerancia. La fiabilidad es adecuada para el primer factor, y moderada o baja para el resto de los factores. La NDSS-T y sus escalas correlacionan significativamente con el Test de Dependencia de la Nicotina de Fagerström (FTND), con los criterios de dependencia de la nicotina del Manual Diagnóstico y Estadístico de los Trastornos Mentales-IV (DSM-IV), evaluados mediante la Entrevista Clínica Estructurada para el DSM-IV (SCID-IV), con el nivel de monóxido de carbono en aire espirado (CO), y con el número de cigarrillos fumados al día. La curva ROC indica que la NDSS-T tiene una puntuación de .79 bajo la curva (.69 para el FTND), lo que indica que la predicción de la dependencia de la nicotina es adecuada. Se concluye que este instrumento es útil (en relación a la puntuación total NDSS-T) para evaluar la dependencia de la nicotina en fumadores españoles (en España), tal y como se ha encontrado en otros países, lenguas y culturas.

Palabras clave: fumar, evaluación, dependencia, nicotina, NDSS.

This study was partially funded by a grant for research projects awarded by the Comité Nacional para la Prevención del Tabaquismo (CNPT). The present study was conducted within the framework of the collaboration agreement between the University of Santiago de Compostela, Spain (Tobacco Addiction Unit) and the Servicio Andaluz de Salud (Distrito Sanitario Málaga).

We would like to thank Saul Shiffman for authorizing our use of the NDSS in Spain. We also thank those who made it possible to carry out the study at the primary health care centers involved: Dr. Manuel Bacariza Cortiñas, Centro de Salud de Vite (Santiago de Compostela), Dr. Lorenzo Pousa Estévez, Centro de Salud de Bayona (Pontevedra), Dra. Sonia Manget Velasco, Centros de Salud de Madrid, Dr. Maximiliano Vilaseca Fortes, Director of the Servicio de Salud de Málaga, and Dr. Santos Agrela Torres, Centro de Salud Trinidad-Jesús Cautivo (Servicio de Salud de Málaga). Finally, we express our gratitude to all of the professionals who participated in the application of the questionnaires and, in particular, to Carmela Martinez Vispo and Gema Díaz Alonso.

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The assessment of nicotine dependence is important in the analysis of smoking behavior. The addictive power of nicotine explains why many smokers repeatedly fail in their attempts to quit smoking. This power has been consistently shown in a large number of studies, for example, the United States Department of Health and Human Services (1988, 2004). Despite the existence of the nicotine dependence criteria of the Diagnostic and Statistical Manual of Mental Disorders, fourth edition (DSM-IV; American Psychiatric Association, 2000) and the International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10; World Health Organization, 1992), the most widely used procedures for assessing nicotine dependence are the Fagerström scales. The original Fagerström Tolerance Questionnaire (Fagerström, 1978) is more than 30 years old, but more recently the Fagerström Test for Nicotine Dependence (FTND; Heatherton, Kozlowski, Frecker, & Fagerström, 1991) has become the most widely used in the field of smoking assessment. The reliability of this six-item test is low, between .56 and .80 for the original version, and .66 for the Spanish adaptation (Becoña & Vázquez, 1998).

The reliability for a good questionnaire is .70 or more (Nunnally & Bernstein, 1994). In recent years, it has been recommended to assess nicotine dependence with scales that are more comprehensive and more closely in line with DSM-IV criteria in view of the low reliability of the FTND.

Actually there are several new scales, such as the Cigarette Dependence Scale (CDS; Etter, 2005) and the Nicotine Dependence Syndrome Scale (NDSS; Shiffman, Waters, & Hickcox, 2004) that address the low reliability of the Fagerström scales and adhere to the DSM-IV criteria. The NDSS is the most utilized of the two. This questionnaire is composed of 19 items and includes five dimensions: Drive (craving, withdrawal, and subjective compulsions to smoke), Tolerance (reduced sensitivity to the effects of smoking), Continuity (regularity of smoking rate), Stereotypy (invariance of smoking), and Priority (preference for smoking over other reinforcers). Moreover, we obtained a total score (NDSS-T) with good reliability (Cronbach's $\alpha = .85$) (Shiffman et al., 2004). The factors proposed by the NDSS are relevant to assess nicotine dependence. Therefore, the NDSS would assess the nicotine dependence syndrome better than the FTND because it evaluates various dimensions (the five proposed), while the FTND evaluates only one dimension. The first studies by Shiffman et al. (2004) with the NDSS confirmed the five factors or dimensions proposed and the utility of the scale which showed both concurrent and predictive validity. Other studies, such as those of Costello et al. (2007) with adolescents, Okuyemi et al. (2007) with Afro-American light smokers, and Piper et al. (2008) with smokers of 10 or more cigarettes per day, have found good reliability for the total scale and for several of the factorially-derived scales.

A relevant concern is the percentage of smokers with nicotine dependence. Hughes et al. (2004) found that the percentage of nicotine dependents identified by the DSM-IV criteria was between 63% and 86% in their different samples. Donny and Dierker (2007) used a sample of 8000 daily smokers in the U. S. between the ages of 18 and over. It was determined that 60.6% of the sample fulfilled the nicotine dependence criteria of the DSM-IV.

We have three principle objectives. The first is to validate the NDSS in Spain for the assessment of nicotine dependence. This measure is extremely useful, both for adults (Shiffman et al., 2004) and adolescents (Clark et al., 2005), as evidenced by its validation in the United States and its adaptation to other countries, languages, and cultures (e.g., Broms et al., 2007). Our expectation is to obtain similar results as the original validation of the NDSS in the U.S.A. (Shiffman et al., 2004). The second is to determine the percentage of nicotine-dependence in the population. This is a concern of great relevance and it has received considerable attention in recent years (Hughes, Heltzer, & Lindberg, 2006). The present study assesses the percentage of Spanish smokers with nicotine dependence attending Primary Health Care Centers. Finally, the third is to analyze the relationship between the DSM-IV, the FTND, and the NDSS with respect to the diagnosis of nicotine dependence.

Method

Participants

The sample was obtained from five Primary Health Care Centers in different cities of Spain: two in Madrid (Vicente Muzas and Garcia Noblejas, Madrid Health Area 4), one in Bayona (Pontevedra province), one in Santiago de Compostela (Vite), and one in Málaga (Trinidad-Jesus Cautivo).

The total sample was composed of 637 daily smokers (105 from Madrid, 155 from Bayona, 171 from Santiago de Compostela, and 210 from Málaga). All participants in the present study smoked one or more cigarettes per day. The exclusion percentage was 25.1% ($n = 213$). People were excluded for various reasons: when they could not talk nor respond at that time, when they were ill, when they declined to respond to the questionnaire due to lack of time or for other reasons, when they refused to sign the informed consent, and when they declined to take the test for carbon monoxide in expired air. Occasional and ex-smokers were also excluded.

The mean age of this sample was 39.26 years ($SD = 12.81$), with a range from 18 to 81. Of these, 265 (41.6%) were male and 372 (58.4%) were female. Data were collected between February and May 2008.

Questionnaire

In addition to the assessment of sociodemographic variables, smoking characteristics, and previous attempts to quit smoking, the following additional assessment instruments were used.

- DSM-IV, nicotine dependence criteria through the SCID (*The Structured Clinical Interview for DSM-IV*; First, Spitzer, Gibbon, & Williams, 1998). The SCID is a semi-structured diagnostic interview that includes as many diagnostic modules as there are diagnostic categories in the DSM. According to the DSM-IV, the diagnostic criteria for substance dependence are the same for all substances. Dependence is defined as a maladaptive pattern of the use of a substance that involves clinically significant deterioration or distress expressed through three or more of a total of seven items, at some point during an uninterrupted 12-month period.
- The Nicotine Dependence Syndrome Scale (NDSS) (Shiffman et al., 2004). The NDSS contains 19 items and assesses a general factor of nicotine dependence and various factors derived from it. The original validation includes the factors of Drive, Priority, Tolerance, Continuity, and Stereotypy. This questionnaire uses a 5-point Likert scale (not at all true; somewhat true; moderately true; very true; extremely true; scores ranging from 1 to 5, respectively). Through a back-translation procedure (Hamblenton, Merenda, & Spielberger, 2005), the Spanish version of the NDSS that we used was obtained from the 19-item version of Shiffman et al. (1994). Three different persons translated it from English to Spanish. Three different persons, who were experts in the field of tobacco and other addictions, revised the translation and agreed on a single version of the scale. Finally, two translators confirmed the Spanish translation of the English version in order to check for equivalence.
- Fagerström Test for Nicotine Dependence (FTND) (Heatherton et al., 1991; Spanish version by Becoña and Vázquez, 1998).This scale is the most widely used instrument for assessing nicotine dependence although its reliability is moderate: .60 in studies in Spain (see Becoña & Lorenzo, 2004). We utilized six (6) as the cut-off point (Fagerström et al., 1996).

Procedure

We contacted the Administrators of the Health Care Centers in which the study was to be carried out, in order to obtain their permission. They were provided with an explanation of the study, a copy of the questionnaire, and a copy of the authorization of the study by the Bioethics Committee of the University of Santiago de Compostela. Once the Administrator of each Health Care Center authorized the study, he or she informed the other professionals of the center and requested their cooperation.

The questionnaires were administered individually by center personnel to patients who were daily smokers (1 or more cigarettes per day for at least the previous month) who were visiting their General Practitioners (GP). They were contacted by interviewers while they were in the waiting room. At that time, the subjects agreed to participate in the study or not.

All participants had an appointment with their doctor on the day of the assessment. The patients' companions were not admitted to the study, even if they were smokers. All of the participants in the study signed the informed consent document. A psychologist trained for the study read and completed the questionnaire, and resolved their doubts, if any. Approximately 10-15 minutes were required to complete the questionnaire.

Once the questionnaire had been completed, the psychologist assessed the level of carbon monoxide in expired air (CO) using a MicroSmokerlyser (Bedfont Technical Instruments, Sittingbourne, Kent, United Kingdom). We used this physiological measure because it is the preferred method for the detection of recent smoking (West, Hajek, Stead, & Stapleton, 2005).

Results

Factor analysis of the NDSS

Given the adequate sample size used (N = 637), the Kaiser-Meyer-Olkin measure of sampling adequacy (.77) indicated that it was appropriate to proceed to a factor analysis. The principal components of factor analysis indicated that the ideal number of factors to extract is 6 using the criterion of 1 or more of explained variance, or 6 or 2 according to the graphic representation of the sedimentation matrix. However, extracting and rotating 5 and 6 factors by means of varimax orthogonal rotation, it was observed that, with 5 factors, the interpretation was correct. This fits almost perfectly with the results of Shiffman et al. (2004) regarding the validation of this questionnaire using U.S. samples. The five factors explained 52.55% of the variance (Table 1). Thus, the factors obtained through varimax orthogonal rotation are perfectly interpretable, such as I-Drive, II-Continuity, III-Stereotypy, IV-Priority, and V-Tolerance. These factors were retained for subsequent analyses. We used a score of .30 or more in the factor loading for retaining the items in each factor (Kline, 1984). Thus, the first scale has 8 items and the rest had 4, 5, 3, and 4, respectively. For the first unrotated factor of the factor matrix (NDSS-T), we retained those items with a loading above .25. As a result, we have 12 items on the total scale. Using the criteria of .30, we

Table 1
Factor analysis (principal components), rotated factor matrix (varimax), 5 factors, Spanish primary care patients (N = 637)

[Spanish version in brackets]	Varimax rotated factors I. Drive	Varimax rotated factors II. Continuity	Varimax rotated factors III. Stereotypy	Varimax rotated factors IV. Priority	Varimax rotated factors V. Tolerance	Unrotated first factor NDSS-Total
1. My smoking pattern is very irregular throughout the day. It is not unusual for me to smoke many cigarettes in an hour, then not have another one until hours later. [Mi forma de fumar es muy irregular a lo largo del día. No es extraño que fume muchos cigarrillos durante una hora y luego no fume ninguno hasta horas después.]	-.155	.458	-.331	-.056	.384	-.157
2. My smoking is not much affected by other things. I smoke about the same amount whether I'm relaxed or working, happy or sad, alone or with others, etc. [Mi forma de fumar no se ve muy afectada por otras cosas. Fumo más o menos lo mismo si estoy relajado o si estoy trabajando, contento o triste, solo o en compañía de otros, etc.]	-.158	-.272	.211	.006	.616	-.015
3. Even if traveling a long distance, I'd rather not travel by airplane because I wouldn't be allowed to smoke. [Si tengo que hacer un viaje largo no me planteo viajar en avión porque sé que no está permitido fumar.]	.204	-.086	.016	.668	.051	.437
4. Sometimes I decline offers to visit with my non-smoking friends because I know I'll feel uncomfortable if I smoke. [A veces dejo de visitar a mis amigos no fumadores porque sé que me sentiré incómodo si fumo.]	-.010	.008	.037	.766	.074	.299
5. I tend to avoid restaurants that don't allow smoking, even if I would otherwise enjoy the food. [Tiendo a evitar los restaurantes donde no se permite fumar, incluso aunque me guste su comida.]	.266	.154	.103	.589	-.115	.474
6. I smoke consistently and regularly throughout the day. [Fumo de forma constante y regular a lo largo del día.]	.372	-.100	.674	.148	.053	.549
7. I smoke at different rates in different situations. [Fumo distinta cantidad de cigarrillos en función de la situación en la que esté.]	.027	.771	-.047	-.120	-.110	-.003
8. Compared to when I first started smoking, I need to smoke a lot more now in order to get what I really want out of it. [Comparado con cuando empecé a fumar, necesito fumar mucho más ahora para conseguir el mismo efecto.]	.470	.186	-.089	.146	.465	.524
9. Compared to when I first started smoking, I can smoke much, much more now before I start to feel nauseated or ill. [Comparado con cuando empecé a fumar, ahora puedo fumar mucho más sin llegar a sentir náuseas o malestar.]	.202	.181	-.009	-.007	.705	.283
10. After not smoking for a while, I need to smoke in order to keep myself from experiencing any discomfort. [Tras pasar un tiempo sin fumar, necesito hacerlo para no sentirme mal.]	.712	.010	-.039	.167	-.044	.675
11. [It's hard to estimate how many cigarettes I smoke per day because the number often change. [Es difícil saber cuántos cigarrillos fumo al día porque el número suele variar.]	.075	.527	-.032	.104	.137	.148
12. I feel a sense of control over my smoking. I can "take it or leave it" at any time. [Tengo sensación de control sobre el tabaco. Puedo cogerlo o dejarlo en cualquier momento.]	-.576	.030	-.029	-.009	.076	-.506
13. The number of cigarettes I smoke per day is often influenced by other factors - how I'm feeling, what I'm doing, etc. [El número de cigarrillos que fumo al día varía según distintos factores: cómo me siento, qué estoy haciendo, etc.]	.030	.818	-.061	.048	-.026	.074
14. When I'm really craving a cigarette, it feels like I'm in the grip of some unknown force that I cannot control. [Cuando realmente deseo un cigarrillo, parece que estoy bajo el control de alguna fuerza desconocida que no puedo dominar.]	.583	.067	.056	.207	.190	.636
15. Since the time when I became a regular smoker, the amount I smoke has either stayed the same or has decreased somewhat. [Desde que me he convertido en un fumador habitual, la cantidad que fumo ha sido la misma o ha disminuido un poco.]	-.391	.108	.583	-.072	.054	-.216
16. Whenever I go without a smoke for a few hours, I experience craving. [Siempre que estoy sin fumar durante algunas horas, siento unas ganas muy fuertes de hacerlo.]	.744	.027	.178	.083	.118	.748
17. My cigarette smoking is fairly regular throughout the day. [Mi consumo de cigarrillos es bastante regular a lo largo del día.]	.286	-.109	.723	-.059	-.187	.373
18 After not smoking for a while, I need to smoke to relieve feelings of restlessness and irritability. [Después de estar un tiempo sin fumar, necesito hacerlo para aliviar las sensaciones de inquietud e irritabilidad.]	.780	.074	.082	.063	-.001	.735
19. I smoke about the same amount on weekends as on weekdays. [Fumo la misma cantidad de tabaco durante la semana que en el fin de semana.]	-.042	-.161	.523	.194	.235	.187

have 10 items, with two of them approaching the limit of .30 (.29 and .28). Each scale was calculated by assigning items to scales according to their highest factor loading, as suggested by Clark et al. (2005).

Reliability of the scales

We assessed the internal consistency of the overall NDSS subscales and the NDSS-T scale by computing Cronbach's α coefficient for the sample. The results indicated adequate reliability for the total scale (NDSS-T, α = .76) which is formed by 12 items of the first unrotated factor. With respect to the reliability of the rest of the scales, it is adequate for Drive (.74), and moderate or low for the remainder (.60 for Continuity, .56 for Stereotypy, .43 for Priority, and .39 for Tolerance).

The analysis of reliability by items on each of the scales confirmed the previous results. All items of the total scale had very good reliability (from .72 to .77). Reliability was also adequate for the Drive factor (from .68 to .76) but low for the rest of the factorially derived scales.

In the present sample, the reliability obtained for the FTND by means of Cronbach's α coefficient was .65.

Concurrent validity

The concurrent validity (assessment of the same construct with different methods) of the NDSS was evaluated by correlating the NDSS measures with the FTND, the DSM-IV criteria, and the smoking rate. The results indicated that the correlation between the NDSS-T and the FTND and SCID is high and significant, with values of .58 ($p < .001$) between the NDSS-T and FTND, and .56 ($p < .001$) between the NDSS-T and SCID. In turn, the correlation between the FTND and the SCID was .38 ($p < .001$). The correlation between the NDSS-T and the number of cigarettes smoked per day was significant ($r = .46$, $p < .001$), as was the assessment of the CO level ($r = .29$, $p < .001$).

A more detailed analysis of each of the NDSS items indicated that almost all of the 19 items correlated significantly with the NDSS-T, the FTND, the SCID, the assessment of CO level, and the number of cigarettes smoked per day (Table 2).

In turn, using the SCID criteria of dependence (3 or more) or non-dependence (0-2), or the FTND criteria (6 or more: dependent; less than 6: non-dependent), we found that the NDSS-T and the scales of Drive, Stereotypy, Priority, and Tolerance differentiated between dependent and non-dependent smokers with the FTND, with scores always higher in dependents. In accordance with the SCID, dependent smokers scored significantly higher on the NDSS-T, Drive, Continuity, Priority, and Tolerance (Table 3).

Characteristics of the smokers according to the NDSS assessment

The NDSS-T and the different scales are good discriminators of smokers' demographic and cigarette consumption characteristics.

Using the raw scores, we found significant differences in the factors of Continuity and Stereotypy according to sex and age. Females scored higher on Continuity than males (Males = 12.94, Females = 14.09, $t = -3.294$, $p < .01$), while males scored higher in Stereotypy than females (M = 16.59, F = 14.91, $t = 3.921$, $p < .001$). By age groups, the youngest scored higher in Continuity (14.26 vs. 12.82, $t = 4.189$, $p < .001$) and the eldest scored higher in Stereotypy (14.41 vs. 17.11, $t = -6.470$, $p < .001$). Considering marital status, Single people ($n = 242$), Married people ($n = 317$),

Table 2
Correlations between scales, CO level, and cigarette consumption

	I. Drive	II. Continuity	III. Stereotypy	IV. Priority	V. Tolerance	NDSS-T
FTND	.57***	-.01	.24***	.37***	.23**	.58***
SCID	.59***	.18***	.00	.27***	.22**	.56***
Nº cigarrettes per day	.44***	-.03	.21***	.31***	.26**	.46***
CO Level	.31***	-.09*	.16***	.13**	.09*	.29***
I. Drive	1.00	.03	.17***	.38***	.29**	.92***
II. Continuity	.03	1.00	-.43***	.01	.36**	.01
III. Stereotypy	.17***	-.43***	1.00	.15***	-.19**	.37***
IV. Priority	.38***	.01	.15***	1.00	.10*	.57***
V. Tolerance	.29***	.36***	-.19***	.10**	1.00	.36***
Total NDSS	.92***	.01	.37***	.57***	.36**	1.00

Note: FTND = Fagerström Test for Nicotine Dependence
SCID = The Structured Clinical Interview for DSM-IV
*** $p < .001$

Table 3
Dependence/non-dependence with the SCID and the FTND on the NDSS-T and subscales

	FTND			SCID		
	Non- dependence Mean (*SD*)	Dependence Mean (*SD*)	t	Non- dependence Mean (*SD*)	Dependence Mean (*SD*)	t
I. Drive	21.86 (7.90)	29.42 (6.90)	-10.865***	17.23 (6.38)	26.41 (7.56)	-14.419***
II. Continuity	13.55 (4.40)	13.79 (4.31)	-.599	12.32 (4.92)	14.13 (4.08)	-4.773***
III. Stereotypy	15.13 (5.37)	17.00 (5.20)	-3.844***	15.84 (5.34)	15.52 (5.40)	.678
IV. Priority	4.23 (2.05)	6.17 (2.95)	-9.244***	3.97 (1.91)	5.02 (2.60)	-4.919***
V. Tolerance	11.52 (4.30)	13.32 (4.22)	-4.635***	10.81 (4.55)	12.44 (4.18)	-4.333***
NDSS-T	30.08 (9.47)	40.20 (8.76)	-11.992***	25.33 (7.62)	35.59 (9.74)	-12.706***

*** $p < .001$

Table 4
Differences in various sociodemographic characteristics

		Sex			Age			Marital status			
		Males	Females	t	18-40	>40	t	Single	Married	Others	F
I. Drive	Mean	23.42	24.06	-.960	23.43	24.23	-1.207	23.88	23.53	24.64	.570
	SD	8.45	8.26		8.38	8.28		8.59	8.26	7.89	
II. Continuity	Mean	12.94	14.09	-3.295**	14.26	12.82	4.189***	14.27	13.29	12.91	4.671*$_1$
	SD	4.51	4.23		4.14	4.55		4.17	4.38	4.78	
III. Stereotypy	Mean	16.59	14.91	3.921***	14.41	17.11	-6.470***	14.83	15.91	16.82	5.044**$_2$
	SD	5.32	5.33		5.04	5.42		5.17	5.42	5.60	
IV. Priority	Mean	4.73	472	.064	4.58	4.89	-1.549	4.72	4.56	5.38	3.449*$_3$
	SD	2.65	2.33		2.19	2.76		2.43	2.27	3.18	
V. Tolerance	Mean	11.63	12.22	-1.690	12.06	11.86	.580	12.31	11.50	12.89	4.419*$_3$
	SD	4.31	4.37		4.15	4.60		4.27	4.37	4.35	
NDSS-T	Mean	32.59	32.73	-1.74	31.96	33.53	-1.914	32.72	32.04	35.10	2.786
	SD	10.24	10.32		10.05	10.53		10.45	10.05	10.45	

Note: $_1$ Significant between single and married, $_2$ Significant between single and others, $_3$ Significant between married and others
* $p < .05$, ** $p < .01$

Table 5
Aspects related to smoking on the NDSS scale

		Daily number of cigarettes			Have you tried to give up smoking in the last year?		
		1-19	20 or more	t	Yes	No	t
I. Drive	Mean	20.71	26.84	-9.957***	24.50	23.52	1.326
	SD	7.97	7.54		8.68	8.19	
II. Continuity	Mean	13.93	13.31	1.793	13.39	13.70	-.804
	SD	4.56	4.18		4.17	4.46	
III. Stereotypy	Mean	14.37	16.84	-5.941***	15.41	15.69	-.591
	SD	5.26	5.23		5.39	5.39	
IV. Priority	Mean	4.12	5.32	-6.319***	4.13	4.95	-3.801***
	SD	1.92	2.78		2.04	2.58	
V. Tolerance	Mean	11.06	12.88	-5.383***	11.82	12.04	-.585
	SD	4.14	4.37		4.29	4.38	
NDSS-T	Mean	28.68	36.60	-10.517	32.81	32.62	.205
	SD	9.33	9.66		9.78	10.48	

*** $p < .001$

and Others (n = 78: separated, divorced, or widowed), we detected differences on the following factors. Single people scored significantly higher on Continuity than did Married people; Others scored higher on Stereotypy than Singles; and Others produced higher scores on Tolerance than did Married (Table 4).

With respect to cigarette consumption (smokers of 1-19 cigarettes vs. smokers of 20 or more per day), we found significant differences on the NDSS-T and on four of the five scales (Drive, Stereotypy, Priority, and Tolerance). Smokers of 20 or more cigarettes per day scored highest on all scales. There were no significant differences between those who smoked 1 to 19 cigarettes per day and those who smoked 20 or more per day on Continuity. There were only differences on the Priority scale between participants who had attempted to give up smoking in the previous year and those who had not. Smokers who didn't try to give up obtained higher scores (Table 5).

Prediction of nicotine dependence (SCID) with the NDSS using ROC curves

A ROC (Relative Operating Characteristic) curve is a graphic method that determines the optimum point of classification based on the differentiation functions between two groups. In addition, the ROC curves make it possible to determine the optimum cut-off point in the assignment of cases to groups. The ROC curve is a graphic plot of sensitivity vs. specificity for a binary classification system due to the fact that the discrimination threshold is varied (Franco, 2007). The ROC can also be represented by plotting the fraction of true positives (TPR = true positive rate) vs. the fraction of false positives (FPR = false positive rate). This is also known as a ROC curve because it is a comparison between two operating characteristics (TPR & FPR) as the criteria change.

We use the dependence criterion of the SCID (3 or more positive items) as a predictive variable. The five scales of the NDSS and the NDSS-T scale were predicted variables.

The results of the SCID indicated that 456 smokers were nicotine-dependent (71.58%) and 181 were non-dependent (29.41%). Both the NDSS-T (with a value of .79) and the scores for four of the five scales were greater than .50 under the curve: Drive with .82, Continuity with .60, Priority with .62, and Tolerance with .61. Only Stereotypy was below .50 (.48). Therefore, the prediction was significant in all cases except for Stereotypy (Figure 1).

When we compared the functioning of the NDSS-T scale with the FTND, we found that both provided good predictions of dependence. But the NDSS-T scale, with a score of .79 under the curve, has a better level of prediction than the FTND (.69 under the curve). This indicates that both are good discriminators of dependent and non-dependent smokers, even if the NDSS-T offers the best prediction.

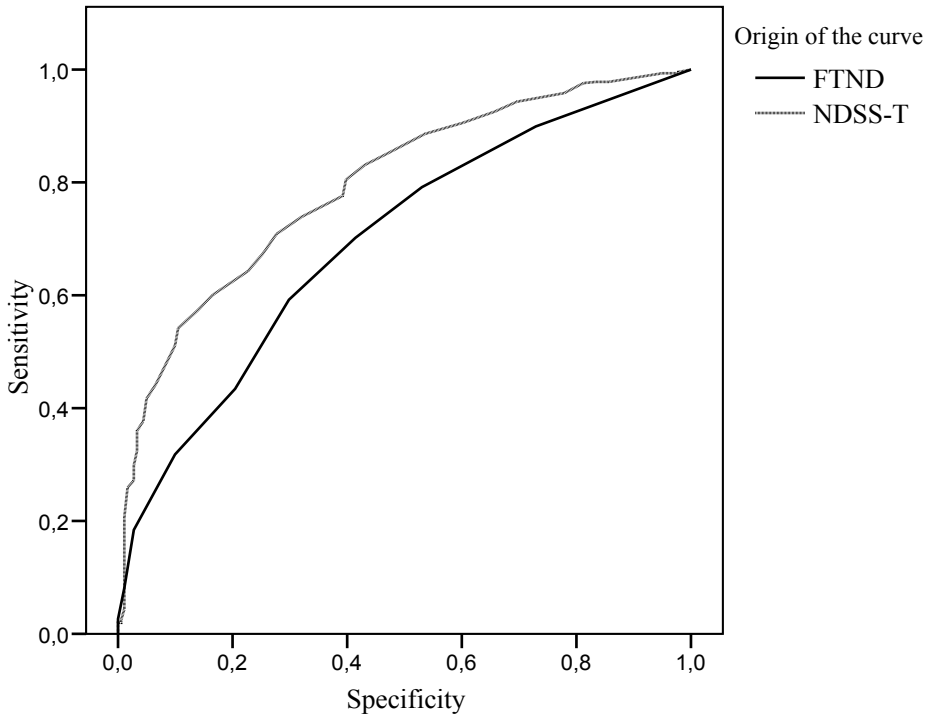

Figure 1. ROC curves of the FTND and NDSS-T in relation to dependence/non-dependence assessed with the SCID.

Prediction of dependence

We included the five factors of the NDSS, its total score (NDSS-T), the FTND, the daily number of cigarettes, and the CO level (all continuous) in stepwise multiple regression for predicting the number of symptoms on the SCID. The results indicated that the only significant variables were the first and second factors of the NDSS (Drive, *Beta* = .579 and Continuity, *Beta* = .167) (*R* = .608). When we used the number of cigarettes smoked per day, the FTND, the NDSS-T, and CO level, the only significant variable was the NDSS-T (*R* = .56, *Beta* = .56).

Discussion

The results of our study provided support for our expectations as stated in the Introduction.With a representative sample of daily smokers attending Spanish primary health care centers, we obtained five factors similar to those of Shiffman et al. (2004): Drive, Continuity, Stereotypy, Priority, and Tolerance. Only the first factor, Drive, showed adequate reliability, higher than .70.

The first unrated factor (NDSS-T) included 12 of the 19 items of the scale and it had adequate reliability (α = .76). These findings are similar to the Piper et al. (2008) study that used three different samples of cigarette smokers (10 or more per day) and the Okuyemi et al. (2007) study of light smokers, although the reliability levels were lower than those obtained by Shiffman et al. (2004). However, in all of the studies cited including the present one, the reliability of the total scale was adequate.

An analysis of the total scale and the five NDSS factors indicated their discriminative utility as a function of daily cigarette consumption, CO level, nicotine dependence (FTND), and dependence assessment (SCID), except on the Continuity and Stereotypy scales. Specifically, using the SCID criteria, the NDSS-T and four of five scales (Drive, Continuity, Priority, and Tolerance) discriminated well between smokers.

A high percentage (71.58%) of daily smokers in the present sample was nicotine dependent according to the SCID criteria. Depending upon the type of sample used, research has indicated different percentages of nicotine dependence. Due to the type of sample employed in this study (smokers visiting their GP and representative of the general population), our results are similar to those of Hughes et al. (2004) who found 63% and 86% of dependents in two different studies. These were higher values than those obtained in other epidemiological studies, such as, Breslau, Johnson, Hiripi, & Kessler (2001) and Donny & Dierker (2007) that determined 62.8% and 60.6% of nicotine dependence, respectively. The identification of a high percentage of dependent smokers in our study may be due to the fact that smokers are more likely to fall ill precisely because they smoke (U. S. D. H. H. S., 2004) which leads them to visit their GP more often.

The ROC curves indicated that only the first two factors of the NDSS were adequate for predicting nicotine dependence vs. non-dependence according to the SCID. These were the two scales with the highest reliability levels and those that worked best in relation to the other scales (α coefficients of .74 and .60). If we use the NDSS-T, the prediction level is good with a value of .79 under the curve, and better than the FTND. This also indicated that both the NDSS-T and the FTND assess a substantial part of the variance of nicotine dependence as evaluated with the SCID.

Another relevant result of this study was the predictive capacity of the NDSS-T in relation to others traditionally used for determining the nicotine dependence level or the level of smoking. A multiple regression analysis indicated the utility of the NDSS because of its high level of prediction of nicotine dependence. It was also a better predictor than the other criteria, such as, the number of smoked cigarettes per day, the CO level, and the FTND scale.

Correlation analysis of the different variables of the study indicated that the correlation between the NDSS-T and other scales or variables related to smoking were high and always significant with the FTND (r = .58) and with the SCID (r = .56). Also, the correlation between the NDSS-T with the number of cigarettes smoked per day was high (r = .46), but it was low when correlated with the CO level (r = .29). These results indicated that different scales (as well as cigarette consumption and smokers' CO scores) have important elements in common and that the NDSS-T is highly related to all of them. Perhaps the most important finding was that the correlation of the SCID was equivalent to the NDSS-T and the FTND.

The main conclusion of this study was that, in this Spanish sample, the NDSS-T had both adequate reliability and discriminative power. However, the scales derived factorially did not. The NDSS-T (12 items) proved to be a brief and useful instrument for nicotine dependence assessment.

As Kassel (2000) pointed out, "the operationalization of the construct of nicotine dependence is still a work in progress and, as such, there is no gold standard with respect to its assessment" (p. 32). The present study demonstrates the truth of this assertion. We need to understand nicotine dependence, to have adequate assessment instruments (preferably brief; de Leon et al., 2003), and to explore their predictive capacity. Hence there is a need to continue research in this area, both at the theoretical level and at the level of developing new assessment instruments (Brandon, Herzog, Irwin, & Gwaltney, 2004).

There are three major limitations in the present study. The first limitation is the type of sample used. It is always desirable to have as large and varied a sample as possible, although the one used here represents a type of smoker of great relevance in terms of intervention because smokers visit their GP most frequently. The second limitation concerns the number of measures used for assessing

nicotine dependence. It would be ideal to use a larger number of them. And the third limitation concerns the need for more detailed information on people's smoking history.

In summary, we have used the method of factor analysis in order to assess the validity of the NDSS in a Spanish sample. Our results confirm the five factors of the original validation. We also found that reliability is adequate for the first factor and that the NDSS-T is an adequate predictor of nicotine dependence. Therefore, we conclude that the NDSS is useful for assessing nicotine dependence in smokers attending on Spanish health care centers. We believe that the results are heuristic and provide a useful instrument for the assessment of nicotine dependence in a variety of clinical and investigation contexts.

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Received May 13, 2009
Revision received December 3, 2009
Accepted February 13, 2010